***Which pedagogical practices and methods best support learning digital competences?***

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**1. Introduction**

There were two main aspects considered in answering the question. First, we had to consider what issues to include in the definition of “digital competences”. Studies about pedagogical practices and methods do not necessarily directly use the term “digital competence” but discuss, for example, “digital literacy”, “information seeking skills” or “ICT skills”; partly because there is not yet any established way to use the concept (see also the answer about defining the concept of digital competence), and partly because it is easier to do empirical research on some narrower skill that can be defined more accurately. In the answer below, original author’s definition of the skill is mentioned when reviewing the results if relevant, to make it clear what kind of skill learning has been investigated in the referred articles.

Second, also the concept “pedagogical practices and methods” can mean multiple issues. We have interpreted it to mean various types of tasks, ways of working or types of activities and practices according to which pupils or students are directed or instructed to act by the teacher in school lessons or in other pedagogical setting that has been the object of study in the reviewed publications. Some articles include results of learning activities from informal learning settings, in which there is not any systematical pedagogical effort included in organizing the participants’ activities (see also the question about formal/informal learning?).

Even though the main focus of the review is in school education, some studies reporting experiences from higher education are also included to give more examples and viewpoints in the answer.

*Minna: what about mentioning that results are often bi-outcomes?*

**2. Various methods to teach digital competences**

*Digital competence develops in contextual activities and technology-rich and long-term settings*

There were actually not studies found were pedagogical methods supporting digital competence was directly investigated through empirical study settings, or the methods used were very descriptive, explorative or narrative. The reason for that probably is the complex and gradually developing nature of such competences, which makes it impossible to investigate them trough controlled experimental methods. Some studies focused on investigating methods of using information and communication technology (ICT) in education generally or in teaching some subject domain content (e.g. Mitchell & Dunbar, 2006; Robin, 2008), and referred to digital competence or related concept as one element in that more overarching activity. Some studies examined teachers’ opinions through surveys (e.g. Benes, 2008) or students’ self-reflections (e.g. Bouhnik & Giat, 2009; Lam, 2009; Lei, 2010) about the good ways to support the development of digital competence or related skills. Some articles provided policy-related suggestions for supporting students’ digital competence, without presenting explicit evidence-based results (e.g. Pruulmann-Vengerfeldt, Kalmus & Runnel, 2008).

Based on the reviewed articles, many researchers appear to share the opinion that the pedagogical settings and methods supporting the development of digital competence include rich and integrated use of various technical tools, and wide range of activities that are based on complex and challenging tasks including, for instance, students’ own knowledge creation or product construction, solving of multidisciplinary problems and collaborative activities Pruulmann-Vengerfeldt et al., 2008; Tierney, Bond & Bresler, 2006) and project work (Erstad, 2010). Similarly, Labbo (2006) say, speaking about the development of new literacies, that transformation of teaching practices (literacy instructions) occur in classrooms where computer technologies are integrated throughout the day and across the curriculum. It was emphasized that skills and competencies related to using technology should not be seen narrowly, consisting only on mechanical skills of using some software application; therefore, also the methods for learning the skills require practicing them in settings where multiple technological tools are used integratively in “authentic” ways and for as real purposes as possible. Examples of such activities and tasks were rapid prototyping with realistic resources and tools (Dlodlo & Beyers, 2009); problem-solving games that give school teams complex, real-life contextualized problems, asking them to systematically use various information sources to create solutions (Turcsányi-Szabó, Bedő, & Pluhár, 2006); or digital storytelling (Robin, 2008).

Two studies (Ilomäki & Rantanen, 2007; Rutledge, Duran & Carroll-Miranda, 2007) reported a research endeavour where the development of ICT skills was examined in a long-term setting where laptops were given to a group of students and their extensive usage was implemented in the teaching practices of the group for three years. Conclusions from the studies were that rich and versatile usage of technology through laptops both in school and out school settings in various activities, projects and school subjects developed all participants’ necessary basic digital competences. In addition, as Ilomäki and Rantanen (2007) reported, voluntary possibilities to participate in challenging ICT-related projects provided some students’ with ICT expertise that resembles professional expertise.

Also studies that based their evidence on students’ own reporting of the increase in their digital competences in a pedagogical intervention, report similar conclusions about the types of practices that may support digital competencies. Lam (2009) investigated secondary school students’ experiences from an international inquiry-based collaboration project, where students used various technological tools such as Knowledge Forum, Slide, Wiki, GoogleDocuments. In addition to content learning, students reported that the project improved, for instance, their skills on critical thinking, proper writing skills on an on-line knowledge building environment, and ICT competence by using some Web 2.0 applications. Lei (2010) concluded, based on a survey and interviews conducted to seventh- and eighth-grade students and teachers that the influence of using technology in education on student outcomes depends more on the *quality* than *quantity* of technology use. He argues that academic achievement should not be the only criterion for evaluating the meaningfulness of technology use; some other outcomes are also important components of school education, including student behavior, attitude, self-esteem, digital literacy and career aspiration.

Ryberg and Dirckinck-Holmfeld (2008) argued that in order to understand how young peoples’ digital literacies are best supported, we should empirically investigate how they actually work with digital media in concrete learning situations. In their study, they investigated a setting where young people from different countries were brought together in an international symposium and had to work collaboratively on solving a challenging open-ended problem.

*The following might be better in Q2. Added there but must discuss.*

Concerning school curriculum and the discussion about whether the skills of using technology should be taught as a separate subject domain, the dominant opinion in the articles was that the best way to support students’ digital competence is to use technology in various school subjects and for various purposes. Allen (2007) stated that there should be a school-wide consensus on goals, methods, and responsibilities about the acquisition of information literacy skills. Based on a survey targeted to teachers in Czech Republic, Benes, Mudrak, Prochazka, Rambousek & Stipek (2008) reported that teachers favour the approach that information education is not limited to the subject information technology itself but the development of information technology competences is supported by the wide usage of ICT in other subjects not directly focused on informatics, and also in various educational information activities that are not directly linked to these subjects. The improvement of digital competencies or related skills can be an important additional goals or side-effects in settings where technology is used in education for other purposes, mainly learning of some subject domain content. Mitchell and Dunbar (2006) investigated the role of computers within the nursery sector as the potential way of introducing young children to computers. Their results indicate that the programs that were in use appeared to provide the children with a range of enjoyable and purposeful learning tasks that enabled the promotion of emergent ICT skills.

*Supporting information literacy skills*

Some studies specifically focussed on examining how information literacy skills, meaning information handling, proper use of digital information resources etc., should be supported in schools. Aznar & González (2010) investigated how to support information problem solving through a Webquest method in secondary education (... Advantages: motivating, real life activities and topics, task-based methodology, facilitating cooperative learning, constructivist structure, real evaluation through an authentic task. Difficulties: takes time, difficulties with ICT and information handling, structuring the task and working together ...). Bouhnik & Giat (2009) examined how quite a long and extensive course with various tasks and activities could provide high school students with applied logical tools. They reported that the course improved students’ critical reading skills, and students themselves felt that they had better analytical and critical skills, change in their reading behaviour. Jones (2007) reported experiences from a college course focusing on the practices of reading and writing with computers and the Internet; in the course, students examine the history of literacy as well as their own literate practices with print and digital texts.

*From print literacy to digital literacy*

One line of research in the reviewed articles was the examination of the ways and methods for teaching digital literacy as an alternative to traditional “print literacy”: Moran et al. (2008), Tan & McWilliam (2009), Tan & Guo (2009).

*Summary*

In the empirical articles the role of digital competence or related concept was only marginal; development of the competencies was a side-effect or argument for using technology, but not actually the focus of research.

**3. Method for answering the question**

***Search procedures***

The searches were conducted using EBSCOhost, which is an on-line retrieval system of scientific articles related to educational, psychological and behavioral sciences. The searches were targeted to two databases in the system: Academic Search Complete and Education Research Complete. The results from these databases were narrowed down by the following restrictions: Articles were to be peer reviewed, in English, published in between 2005-2010 (originally in between 2000-2010, but due to vast amounts of irrelevant hits this was further restricted) and finally the full text was to be available through EBSCOhost with the rights purchased by the University of Helsinki.

The search words used in the process were mainly derived from the vocabulary of the questions and their synonyms. In addition to these, some terms were added using the professional knowledge of the researchers involved in the process.

The process was started with a more general search shared with all the questions related to Digital Competence. This was conducted to roughly estimate the workload and adjust parameters for the search. The search words used in the general search were:

* digital competence\* (all text)
* digital skill\* (all text)
* digital literac\* (all text) AND education (subject terms) AND school (subject terms)
* ICT skill\* (all text) AND education (subject terms) AND school (subject terms)
* ICT competenc\* (all text) AND education (subject terms) AND school (subject terms)
* ICT literac\* (all text) AND education (subject terms) AND school (subject terms)

In addition the following searches were conducted especially for this theme, including searches that produced 0 results:

* ICT competenc\* (all text) AND methods (subject terms)
* ICT skill\* (all text) AND methods (subject terms)
* ICT literac\* (all text) AND methods (subject terms)
* digital literac\* (all text) AND methods (subject terms)
* digital literac\* (all text) AND pedagog\* (subject terms)
* ICT literac\* (all text) AND pedagog\* (subject terms)
* ICT skill\* (all text) AND pedagog\* (subject terms)
* ICT competenc\* (all text) AND pedagog\* (subject terms)
* ICT competenc\* (all text) AND problem-based learning (subject terms)
* ICT skill\* (all text) AND problem-based learning (subject terms)
* ICT literac\* (all text) AND problem-based learning (subject terms)
* digital literac\* (all text) AND problem-based learning (subject terms)
* digital literac\* (all text) AND inquiry-based learning (subject terms)
* ICT competenc\* (all text) AND inquiry-based learning (subject terms)
* ICT skill\* (all text) AND inquiry-based learning (subject terms)
* digital literac\* (all text) AND metacognition (subject terms)
* digital literac\* (all text) AND constructivism (subject terms)
* ICT skill\* (all text) AND constructivism (subject terms)
* ICT competenc\* (all text) AND constructivism (subject terms)
* ICT literac\* (all text) AND inquiry-based learning (subject terms)
* digital literac\* (all text) AND case-based learning (subject terms)
* ICT literac\* (all text) AND case-based learning (subject terms)
* ICT skill\* (all text) AND case-based learning (subject terms)
* ICT competenc\* (all text) AND case-based learning (subject terms)
* ICT competenc\* (all text) AND situational learning (subject terms)
* ICT skill\* (all text) AND situational learning (subject terms)
* ICT literac\* (all text) AND situational learning (subject terms)
* digital literac\* (all text) AND situational learning (subject terms)
* digital literac\* (all text) AND embedded learning (subject terms)
* ICT literac\* (all text) AND embedded learning (subject terms)
* ICT skill\* (all text) AND embedded learning (subject terms)
* ICT competenc\* (all text) AND embedded learning (subject terms)
* ICT competenc\* (all text) AND metacognition (subject terms)
* ICT skill\* (all text) AND metacognition (subject terms)
* ICT literac\* (all text) AND metacognition (subject terms)
* ICT literac\* (all text) AND constructivism (subject terms)

(The term indicated between the parentheses describes which parts of the database the search words were directed to.)

Figure 1: Presenting the results in a matrix, where numbers in each square represent (number of positive results)/(total number of results).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | digital literac\* | ICT skill\* | ICT competenc\* | ICT literac\* |
| methods | 5/24 | 10/29 | 6/9 | 4/7 |
| pedagog\* | 0/1 | 0/3 | 0/0 | 0/1 |
| problem-based learning | 0/1 | 2/4 | 1/1 | 1/2 |
| inquiry-based learning | 0/2 | 0/2 | 1/1 | 0/0 |
| metacognition | 1/3 | 0/0 | 0/0 | 0/0 |
| constructivism | 0/3 | 2/2 | 1/1 | 0/0 |
| case-based learning | 0/0 | 0/0 | 0/0 | 0/0 |
| situational learning | 0/0 | 0/0 | 0/0 | 0/0 |
| embedded learning | 0/0 | 0/0 | 0/0 | 0/0 |

*add Labbo to this table*

As figure 1 shows, the search word “ICT skill\*” used together with other terms produced most hits, but in general the search word “ICT competenc\*” produced the best quality hits.

In addition to the searches into the databases, a manual search of theme related scientific journals, covering one year of publications, was conducted in the University of Helsinki Minerva-library at the campus of cognitive sciences. More articles were also found through the reference listings of articles that came up in the searches. Some of the reference articles were also familiar to the researchers from previous experiences with the field of study.

All in all XX research papers were used in composing the answer.

**4. References**

Allen, S. M. (2007). Information literacy, ICT, high school, and college expectations. *Knowledge Quest, 35*(5), 18-24.

Aznar, V., & González, J. (2010). Interactive resources in secondary education: Design and application. *International Journal of Learning, 17*(2), 181-194.

Benes, P., Mudrak, D., Prochazka, J., Rambousek, V., & Stipek, J. (2008). Research of ICT education in the Czech Republic. *Problems of Education in the 21st Century, 5*, 24-34.

Bouhnik, D., & Giat, Y. (2009). Teaching high school students applied logical reasoning. *Journal of Information Technology Education, 8*, IIP-1; IIP-16.

Dadzie, P. S. (2009). Information literacy in higher education: Overview of initiatives at two Ghanaian universities. *African Journal of Library, Archives & Information Science, 19*(2), 165-175.

Dlodlo, N., & Beyers, R. N. (2009). The experiences of South-African high-school girls in a Fab Lab environment. *Proceedings of World Academy of Science: Engineering & Technology, 37*, 423-430.

Erstad, O. (2010). Educating the Digital Generation. *Nordic Journal of Digital Literacy,* 1, 56–70.

Ilomäki, L., & Rantanen, P. (2007). Intensive use of ICT in school: Developing differences in students’ ICT expertise. *Computers & Education, 48*(1), 119-136.

Jones, D. C. (2007). Thinking critically about digital literacy: A learning sequence on pens, pages, and pixels. *Pedagogy, 7*(2), 207-221.

Labbo, L. (2006). Literacy pedagogy and computer technologies: Toward solving the puzzle of current and future classroom practices. *Australian Journal of Language and Literacy, 29*(3), 199-209.

Lam, P. H. (2009). Quasi-experimental research into the effects of an international collaboration project on Hong Kong secondary school students' learning motivation. *International Journal of Learning, 16*(7), 325-337.

Lei, J. (2010). Quantity versus quality: A new approach to examine the relationship between technology use and student outcomes. *British Journal of Educational Technology, 41*(3), 455-472.

Lovell, S., & Baker, S. (2009). Digital narratives of youth transition. *Youth Studies Australia, 28*(4), 52-59.

Mitchell, D., & Dunbar, C. (2006). Learning and development in the nursery setting: The value of promoting emergent information and communications technology skills. *Child Care in Practice, 12*(3), 241-257.

Moran, J., Ferdig, R. E., Pearson, P. D., Wardrop, J., & Blomeyer, R. L. (2008). Technology and reading performance in the middle-school grades: A meta-analysis with recommendations for policy and practice. *Journal of Literacy Research, 40*(1), 6-58.

Pruulmann-Vengerfeldt, P., Kalmus, V., & Runnel, P. (2008). Creating content or creating hype: Practices of online content creation and consumption in Estonia. *Cyberpsychology, 2*(1), 1-8.

Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory into Practice, 47*(3), 220-228.

Rutledge, D., Duran, J., & Carroll-Miranda, J. (2007). Three years of the New Mexico laptop learning initiative (NMLLI): Stumbling toward innovation. *AACE Journal, 15*(4), 339-366.

Ryberg, T., & Dirckinck-Holmfeld, L. (2008). Power users and patchworking - An analytical approach to critical studies of young people's learning with digital media. *Educational Media International, 45*(3), 143-156.

Tan, J. P., & McWilliam, E. (2009). From literacy to multiliteracies: Diverse learners and pedagogical practice. *Pedagogies, 4*(3), 213-225.

Tan, L., & Guo, L. (2009). From print to critical multimedia literacy: One teacher's foray into new literacies practices. *Journal of Adolescent & Adult Literacy, 53*(4), 315-324.

Tierney, Robert J., Bond, Ernest and Bresler, Jane (2006). Examining Literate Lives as Students Engage With Multiple Literacies. *Theory Into Practice, 45*(4), 359-367,

Turcsányi-Szabó, M., Bedő, A., & Pluhár, Z. (2006). Case study of a TeaM challenge game—e-PBL revisited. *Education & Information Technologies, 11*(3), 341-355.